

[0099]

CLAIMS

[0100] We claim:

- 1 1. A method of reducing the risk of detachment of photoresist from an underlying
2 substrate during development of a photoresist pattern using a fluid developer, comprising:
3 controlling the surface composition of said underlying substrate so that a contact angle
4 formed between said underlying substrate with a developer used to develop said
5 photoresist pattern is about 20 degrees or greater.
- 1 2. A method in accordance with Claim 1, wherein said photoresist pattern contains
2 features which are less than about 120 nm in size.
- 1 3. A method in accordance with Claim 2, wherein said photoresist pattern contains
2 features which are less than about 90 nm in size.
- 1 4. A method in accordance with Claim 3, wherein said contact angle formed
2 between said underlying substrate with a developer used to develop said photoresist
3 pattern is about 30 degrees or greater.
- 1 5. A method in accordance with Claim 1, wherein controlling of said surface
2 composition of said underlying substrate is accomplished by controlling the composition
3 of a depositing film which forms the surface of said underlying substrate.

1 6. A method in accordance with Claim 5, wherein said depositing film is deposited
2 using plasma enhanced CVD.

1 7. A method in accordance with Claim 6, wherein said depositing film is a DARC.

1 8. A method in accordance with Claim 7, wherein an amount of a Group IV
2 element present in said DARC is controlled, whereby said contact angel is controlled.

1 9. A method in accordance with Claim 8, wherein said Group IV element is
2 carbon.

1 10. A method in accordance with Claim 8, wherein said Group IV element is
2 silicon.

1 11. A method in accordance with Claim 8, wherein said Group IV element is
2 germanium.

1 12. A method in accordance with Claim 8, wherein said DARC is an inorganic
2 DARC.

1 13. A method in accordance with Claim 5 or Claim 6, or Claim 7, or Claim 8,
2 wherein said film deposition employs a power input which includes the use of a plurality
3 of frequencies.

4 14. A method in accordance with Claim 13, wherein said power input includes use
5 of a plurality of RF power inputs.

1 15. A method in accordance with Claim 13, wherein said power input includes the
2 use of both microwave and RF power inputs.

1 16. A method in accordance with Claim 1, wherein controlling of said surface
2 composition of said underlying substrate is accomplished by treating said surface with a
3 plasma.

1 17. A method in accordance with Claim 16, wherein said surface being treated is a
2 DARC.

1 18. A method in accordance with Claim 17, wherein said plasma is a hydrogen-
2 comprising plasma which makes hydrogen species available to react with said DARC
3 surface.

1 19. A method in accordance with Claim 18, wherein said plasma is a hydrogen
2 plasma.

1 20. A method in accordance with Claim 17, wherein said plasma is a helium-
2 comprising plasma.

1 21. A method in accordance with Claim 20, wherein said plasma is a helium
2 plasma.

1 22. A method in accordance with Claim 1, wherein controlling of said surface
2 composition of said underlying substrate is accomplished by controlling the composition
3 of a capping layer deposited over a DARC.

1 23. A method in accordance with Claim 22, wherein said depositing film is
2 deposited using plasma enhanced CVD.

1 24. A method in accordance with Claim 22 or Claim 23, wherein said capping layer
2 is silicon-containing.

1 25. A method in accordance with Claim 22 or Claim 23, wherein said capping layer
2 is essentially α -carbon.

1 26. A method in accordance with Claim 24, wherein said silicon-containing capping
2 layer is α -silicon.

1 27. A method in accordance with Claim 1, or Claim 2, or Claim 8, or Claim 16, or
2 Claim 22, wherein said developer is a water-based developer.

1 28. A method in accordance with Claim 27, wherein said developer has the property

2 of being basic.

1 29. A method in accordance with Claim 1 or Claim 2, or Claim 8, or Claim 16, or
2 Claim 22, wherein said contact angle ranges from about 35 degrees to about 90 degrees.

1 30. A method of reducing photoresist poisoning when the photoresist is a
2 chemically amplified positive photoresist which produces an acid in pattern areas of the
3 photoresist which are to be removed upon development, comprising:
4 controlling the surface composition of a substrate underlying said photoresist by
5 plasma treatment of said surface.

1 31. A method in accordance with Claim 30, wherein said plasma treatment employs
2 a plasma generation power input including more than one frequency.

1 32. A method in accordance with Claim 30 or Claim 31, wherein said substrate
2 underlying said photoresist is a DARC.

1 33. A method in accordance with Claim 32, wherein said DARC is an inorganic
2 DARC.

1 34. A method in accordance with Claim 33, wherein said DARC is a silicon-
2 containing DARC, and wherein said plasma used for treatment is a hydrogen-containing
3 plasma.

1 35. A method in accordance with Claim 32, wherein said DARC is an organic
2 DARC, and wherein said plasma used for treatment is a hydrogen-containing plasma.

1 36. A method in accordance with Claim 32, wherein said plasma used for treatment
2 is a helium-containing plasma.

1 37. A method in accordance with Claim 33, wherein said DARC is a silicon-
2 containing DARC, and wherein said plasma used for treatment is a helium-containing
3 plasma.

1 38. A method in accordance with Claim 32, wherein said DARC is an organic
2 DARC, and wherein said plasma used for treatment is a helium-containing plasma.

1 39. A method of reducing photoresist poisoning when the photoresist is a
2 chemically amplified positive photoresist which produces an acid in pattern areas of the
3 photoresist which are to be removed upon development, comprising:
4 controlling the surface composition of a substrate underlying said photoresist by
5 PECVD deposition of a capping film of α -silicon over an underlying inorganic nitrogen-
6 free DARC .

1 40. A method of reducing photoresist poisoning when the photoresist is a
2 chemically amplified positive photoresist which produces an acid in pattern areas of the

- 3 photoresist which are to be removed upon development, comprising:
- 4 controlling the surface composition of a substrate underlying said photoresist by
- 5 PECVD deposition of a capping film of α -carbon over an underlying inorganic nitrogen-
- 6 free DARC .